A STUDY OF THE DIETARY HABITS OF CEREBRAL PALSIED CHILDREN

By

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Submitted to the Faculty of the Graduate School in partial fulfillment of the requirements for the degree of Master of Science in Dentistry, Indiana University, School of Dentistry, 1965.

ACKNOWLEDGMENTS

The author wishes to acknowledge and express his appreciation and gratitude to Dr. Ralph E. McDonald for his advice, guidance and inspiration throughout the author's graduate training and the preparation of this thesis.

The author thanks Dr. Stanley C. Herman for his advice and instruction.

The author is indebted to Dr. Robert R. Buckley for his teaching and supervision in the dental treatment of cerebral palsied children.

The author wishes to acknowledge United Cerebral Palsy Research and Educational Foundation for the fellowship grant without which completion of this study and his graduate training would have been impossible.

Special thanks must be given to Miss Anita Slominski for her assistance in working with cerebral palsied children.

The author wishes to thank Mrs. Carol Sue Rieger for her chairside assistance in rendering dental services for the cerebral palsied.

The author would like to thank Mrs. Sara Snyder for correction of and Mrs. Frances Paternoster for typing and preparing the forms used in this study.

Finally, the author wishes to express his sincere gratitude to his wife, Susan, for the contribution made and support given during the period of his graduate training.

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INTRODUCTION

In the treatment of cerebral palsied children, a dentist is frequently confronted with numerous instances of poor oral hygiene, gingival and periodontal problems, and untreated carious lesions. These conditions present an unlimited challenge to dentistry. Very often, these oral manifestations are related to poor diet; recent literature emphasized the importance of good diet to a program of preventive dentistry.

Some investigators[1, 2] attribute the poor oral status of the cerebral palsied to the neglect of dentists as well as to the parents of these children in failing to provide them with adequate dental care. Many cerebral palsied children do not receive proper dental care because dentists lack knowledge, patience and the technical ability to handle these handicapped children.[3]

Other investigators[1, 4, 5] have reported that the very nature of cerebral palsy is also responsible for the poor oral conditions. Many cerebral palsied children are unable to maintain good oral hygiene and, consequently, create additional dental problems. Toothbrushing is a difficult task for many of these children due to uncontrolled movements of their hands and arms. Removal of food particles from the oral

cavity is definitely a problem because muscular co-ordination in and about the oral structure is lacking. Furthermore, abnormal activities of these same muscles have been related to many malocclusions.[3, 6, 7] Inability to chew, suck and swallow properly has altered the diet of the handicapped children to such an extent that the oral structures are directly and indirectly affected.

Correlations have been made between poor diet and poor oral status; likewise, poor oral status has been associated with the increase in the frequency of between-meal snacks. Good diet has always been considered important for the dental health of normal children and it is even more so for cerebral palsied children.

The results and conclusions drawn from dietary studies have varied significance to dentists, nutritionists, physicians and others interested in this field. Some dietary studies have been conducted on the cerebral palsied but only a few were concerned with their dental problems. This study provides further information about the dietary habits of cerebral palsied children.

REVIEW OF LITERATURE

This study is unique because it is a dentist's evaluation of the dietary habits of cerebral palsied children. For this reason, some aspects of the oral conditions and dental treatment of these children must be reviewed. The following subjects are of interest in establishing a meaningful relationship between dentistry and the dietary habits of cerebral palsied children; each will be considered separately in the review of literature:

1. Cerebral Palsy
2. Oral Status and Dental Treatment of Children with Cerebral Palsy
3. Nutrition, Diet and Dental Health
4. Nutrition and Diet Studies of Children
5. Nutrition and Diet of the Cerebral Palsied

Cerebral Palsy

The first clinical descriptions of cerebral palsy, with a modern philosophy of therapy, were given by Little[8] in 1843. This crippling, paralytic ailment has often been referred to as "Little's disease,"[9] which included all forms of cerebral palsy. Today, we know that what Little described was only one of the many conditions of cerebral palsy. But there is still much confusion and difference of opinion as to

the proper classification and terminology of the various forms of the disease.[10]

According to Perlstein and Barnett,[11] cerebral palsy is any paralysis, weakness, incoordination, or functional aberration of the motor system resulting from a pathological condition in the motor centers of the brain. In 1959, MacKeith and co-workers[12] defined cerebral palsy as a persistent but not unchanging disorder of movement and posture, appearing in the early years of life and, due to a non-progressive disorder of the brain, the result of interference during its development.

The incidence and prevalence of cerebral palsy is also confusing and uncertain. The survey conducted by Andersen[13] in Norway showed an incidence of 1.9 cases of cerebral palsy per 1,000 births. Based on the prevalence in the five to nine year age group (age group with highest incidence) and an average life expectancy of 65 years, the prevalence of cerebral palsy was estimated to be 234 per 100,000 population of all ages.

Perlstein,[14] in 1962, reported that the incidence of cerebral palsy in the United States was approximately one per 150, or 7.5 per 1,000 live births. Then he calculated the prevalence of cerebral palsy to be

approximately 480 per 100,000 population of all ages. In the past, the prevalence of cerebral palsy closely approached that of poliomyelitis. However, with the advent of vaccination against polio, cerebral palsy has become the greatest neurologic crippler of children.

Cerebral palsy is classified according to what characteristics need emphasis. Each method of classification has its usefulness, advantages and disadvantages. The following is the classification of cerebral palsy as proposed by Minear:[15] physiological, topographical, etiological, supplemental, neuroanatomical, functional capacity and therapeutic. In addition, a mental capacity classification is frequently used to describe the extent of cerebral palsy involvement. Heber[16] classified the mentally retarded children according to various intelligence levels.

Oral Status and Dental Treatment of Children with Cerebral Palsy

Oral status of the cerebral palsied. Cerebral palsied children suffer from diseases and abnormal conditions of the oral structures in a manner similar to normal children. The severity and the extent to which these children are affected by such conditions have been reported by many investigators.

Leonard[17] reported that the dental condition of the cerebral palsied patient is likely to be better than that of the average normal individual. He further reported that it is very common to see cerebral palsied children with caries-free dentition.

Generally, the cerebral palsied child's growth and development of dentition and related structures are very much similar to those of the normal child.[2] However, many comparative studies of the oral conditions of cerebral palsied and normal children have revealed more cases of inferior conditions among the handicapped.

Lyons,[3] after examining 50 cerebral palsied children between the ages of 10 and 14 years, reported that 72 per cent of these children had malocclusion of the teeth in varying degrees. His examination disclosed a high incidence of caries in these children, and in nearly all of them there was considerable gingivitis. Because they did not receive adequate dental care, he asserted that these children were dental cripples at the age of 12 years.

High incidence of malocclusion in cerebral palsied children was reported by Jackson[6] and Trausch.[7]

Rosenbaum's[18] evaluation of the occlusion problems in 124 cerebral palsied children revealed that

bruxism, mid-line discrepancies, visceral swallowing, tongue thrusting and buccal crossbites occurred with greater frequency in the cerebral palsied than in the unaffected.

Watson[19, 20] made a survey of dental conditions of 119 cerebral palsied children. A significant correlation was found between Rh incompatability and hypoplastic defects of the enamel. He designated these defects as "the Rh hump and developmental line." The incidence of caries and malocclusion did not differ significantly between the handicapped and normal group, but marginal gingivitis occurred with greater frequency in the cerebral palsied.

A very high incidence of marginal gingivitis was also reported by Weisman[21] in 1956. His study of the gingival and periodontal conditions of 253 cerebral palsied children showed that a majority of them had poor oral hygiene.

Via and Churchill[22] found a high incidence of enamel hypoplasia in subjects with cerebral disorders. The incidence of enamel defects among the cerebral palsied was 68 per cent, compared to only 10 per cent in the control group. Herman[23] also discovered incidence of enamel hypoplasia to be significantly greater in cerebral palsied children than it was in a group of

unaffected children. The enamel defect was observed in 36 per cent of the cerebral palsied children and only in six per cent of the control children.

In 1960, Siegel[24] compared dental conditions of 65 cerebral palsied children to the same number of unaffected children of the same age. He found that the eruption of the primary dentition occurred earlier in the cerebral palsy group and that attrition was quite pronounced. No attrition was found in the unaffected children. He concluded that decalcified and hypoplastic areas are important diagnostic aids in determining the time of brain injury. Developmental anamolies of the dentition were considered not significant; the study further revealed that there was little difference in the DMF (decayed, missing and filled teeth) between the cerebral palsy group and the unaffected group.

Shmarak and Bernstein[25] studied the caries incidence of 81 cerebral palsied children between three and 15 years of age. They observed that the caries incidence of the cerebral palsied was higher; more than 28 per cent of all teeth observed in these children were affected by caries. The incidence of dental caries increased with age except at eight, 12 and 13 years. The decrease in the percentage of children affected by

dental caries at these age levels was expected since carious primary teeth were being lost and new permanent teeth were erupting.

High incidence of dental caries, gingival disease and malocclusion in cerebral palsied children was also reported by Swallow.[4] He concluded that cerebral palsy can affect the oral structures directly as well as indirectly. Among the common findings which affect the mouth directly are the involuntary movements of the face, teeth-grinding, abnormal tongue movements, and poor sucking, swallowing and chewing. Poor dietary habits and the inability to properly manipulate the tooth brush can affect the oral structures indirectly.

Magnussan and DeVal[26] surveyed the oral conditions of 76 Swedish cerebral palsied children. A control child of the same sex and age was selected for each cerebral palsied child. Complete records of oral conditions were obtained for each child, and medical data were made available from the hospital journals and treating physicians. These investigators found that the cerebral palsied children had more caries and that the incidence of gingivitis was three times higher than in the normal children. Sixty-five per cent of the cerebral palsied children and 20 per cent of the control children had some form of gingivitis.

Hyperplastic gingivitis was common in the cerebral palsied children. No significant difference was noted in the number of mineralization disorders, anamolies or accidental injuries, but bruxism and attrition were more common in the cerebral palsy group. The authors concluded that the higher incidence of caries and gingivitis in these children was due to the difficulties encountered in maintaining good oral hygiene.

Dental treatment of the cerebral palsied. A survey of 100 cerebral palsy patients conducted by Buckley and Slominski[27] revealed that the majority of these patients had received no previous dental care.

It has been estimated that the need of the cerebral palsied for dentistry is significantly greater than that for the normal population.[3, 4, 28] Lack of dental care in these children has been ascribed to ignorance and neglect on the part of both the parents and the dental profession as well as to the very nature of cerebral palsy.

O'Leary,[1] in describing the dentists' fear and lack of knowledge of the conditions of cerebral palsy, stated that many dentists are unfamiliar with the conditions of cerebral palsy and are not able to operate confidently on these children. Wessels[2]

stated that the blame for neglect of the cerebral palsieds' dental needs must be jointly shared by the parents of the children and the dental profession. The dentist's lack of knowledge concerning cerebral palsy and the parents' reluctance to provide dental care, thinking that it is impossible to treat them properly, have created serious dental problems for these handicapped children.

Goldman,[29] in his clinical observation of children suffering from cerebral palsy, muscular dystrophy, or other mental and nervous diseases, found a high rate of gingival lesions in these children and reported that the dental problems of handicapped children have been ignored in the past.

Lindahl[30] emphasized that the cerebral palsied child is a handicapped child. Because of these handicapped conditions, parents will frequently be overaffectionate and overprotective. Very often parents will have some feeling of sympathy toward the child and show their affection by giving him more "sweets" than normally would be given, thereby contributing further to his dental problems.

Both Kauffman[31] and Album[32] stressed the importance of providing good dental attention for the cerebral palsied; in dental care, each patient must be

managed as an individual since no standardized procedure can be made applicable to every cerebral palsied child.

In stressing the importance of good dental care for the cerebral palsied, Wessels[2] has stated that since the handicapped child often has physical problems that make the performance of such apparently routine tasks as eating and talking difficult, it is important that these problems not be aggravated further by dental neglect.

Nutrition, Diet and Dental Health

Effect of nutrition and diet on teeth. Bunting et al.[33] and Howe et al.[34] demonstrated significant reduction in the dental caries activity with improved dietary intake. Other studies[35, 36] showed that children with better dietary intake had better dental conditions. Many studies have revealed that nutrition during the time of tooth development plays a very important role in the caries experience of man.

Sheldon et al.[37] examined ground sections of 95 teeth from 34 patients with detailed medical histories to determine whether defects in enamel structures were related to the occurance of systemic

ailments. Positive correlation between the enamel defects and systemic disability was shown in more than 70 per cent of the subjects. The most common causes of defective enamel formation were deficiencies in vitamins A, C, D and also of calcium and phosphorus.

Sobel and Hanok[38] also reported the importance of a proper calcium-to-phosphorus ratio in the diet during the period of tooth calcification.

Perhaps the most significant nutritional influence on developing teeth is the ingestion of fluorides during the calcification of the teeth.[39-43] Studies have revealed that the rate of caries attack can be reduced quite significantly with the addition of minute amounts of fluoride in the drinking water. A recent study by Tank and Storvick[44] has indicated that prevalence of even malocclusion and gingivitis may be significantly reduced by means of communal fluoridation. However, a study conducted by Davis[45] demonstrated lack of relationship between occlusion and the fluoride content of the communal water supply. Moore's[46] study, likewise, revealed that the fluoride content of the water supply did not influence the severity of gingivitis.

Berk,[47] in 1943, demonstrated that the diet of

the mother during pregnancy was an influencial factor in the calcification of the child's teeth. His study further revealed that the most significant single factor in dental caries was the child's dietary habits at the time of the study.

Sognnaes[48, 49] also reported that dental health can be affected by poor nutrition during the time of the growth of the embryo and stated that the structure and the quality of the teeth themselves are important factors in considering susceptibility of teeth to decay. He studied the dental caries susceptibility of various animals including man and found considerable caries development if they were placed on a purified high sugar diet during tooth development and continuing after tooth eruption. If on the other hand, the diet consisted of natural or unrefined food products during the tooth development, the animals remained relatively caries-free even when a high sugar diet was given during later life.

MacLeod[50] reported that faulty diet during pregnancy can result in many abnormalities. Since the teeth are quite well developed at the time of birth, nutritional adequacy of the mother during pregnancy can very well influence the future oral health of the child. Congenital defects, greater susceptibility

to caries, poorly formed teeth, poor calcification of bones at birth and even malocclusions have been associated with nutritional deficiency during prenatal life. Educating the mothers as to the importance of good nutrition can minimize these various developmental defects in children.

Many local factors are involved in caries development. Fosdick[51] demonstrated the effect of simple oral hygiene procedure on reduction of dental caries. Brushing with a neutral dentifrice or even rinsing after ingestion of food was shown to reduce the dental caries activity.

Kite et al.[52] showed that food must be present around the teeth for caries to develop. When caries-susceptible albino rates were fed a caries-producing diet by stomach tube, they did not develop tooth decay. On the other hand, all control litter mates but one which were fed the same diet orally had tooth decay.

Orland et al.[53] studied germ-free rats and reported that rats maintained free of bacteria did not develop dental caries.

Such properties of saliva as viscosity, pH, flow, buffering capacity, organic as well as inorganic content and ionic strength have all been

associated with the development of caries. Bixler et al.,[54] in 1954, demonstrated the effect of desalivation on the dental caries activity. Pronounced increase in the incidence and severity of dental caries was noted when the animals were desalivated.

The direct effect of carbohydrate on dental caries has been supported quite consistently by many studies conducted in the past.

Shaw,[55] in 1954, showed that even the highly caries-susceptible strain of rats remained caries free when they were fed diets which were low or free in carbohydrate content.

Gustafson et al.,[56] in 1954, after studying the relationship of carbohydrate to dental caries, concluded that consumption of sugar can increase caries activity. Sugar which was readily cleared from the surfaces of teeth had relatively low cariogenic potentials. Sugar in a form of solution consumed at mealtime did not increase the dental caries activity; however, consumption of sugar which was easily retained on the surfaces of the teeth increased greatly the caries activity. Caries activity was found to be the greatest when easily retained, sugar-rich food was consumed between meals. With a decrease in sugar-rich food, caries activity decreased. However,

Gustafson and co-workers concluded that dental caries will continue to appear despite the avoidance of refined sugar, maximum restriction of natural sugars and total dietary carbohydrates.

Savara and Suher[57] studied the food and oral hygiene habits of 279 children one to six years of age. The results showed no correlation between dental caries and the income of the parents or the number of times per week the children consumed various desserts and between-meal items. The oral hygiene habits were also negatively associated with the parents' income. However, the education of the parents was directly associated with the number of times per day the children brushed their teeth.

Potgieter et al.,[58] in 1956, surveyed the dental status and food habits of 864 Connecticut children. A lower DMF rate was found in children who had better dietary intake on the basis of the basic seven food groups. A lower DMF rate was found in children who consumed a greater amount of fruits and vegatables. A consistent improvement in dental status was noted with an increase in the number of cups of milk consumed, although the DMF rate of those children consuming more than five cups of milk per day was noted to be slightly higher than in children consuming four

to five cups per day. There was a slight positive correlation between the DMF rate and the frequency of between-meal snacks. The DMF rate for boys did not differ from that of girls. When the DMF rate for rural children was compared to that of city children, rural children had a slightly lower DMF rate.

Slack and Martin,[59] in 1958, investigated the effect of an apple eaten after meals. They found that the gingival condition and the incidence of caries were significantly better in the apple group than in the control group.

Cran,[60] in 1959, found a low caries incidence in the Australian aborigines who subsist partly on a primitive diet which is high in protein and low in refined carbohydrate. The histological structures of the teeth did not appear to be responsible for the high resistance to caries, and fluorine in the water was considered to play a less important role than the diet in controlling dental caries. Therefore, he concluded that by proper selection and cooking of food, it is possible to provide a nutritious diet which will maintain the oral tissues free from disease.

Zita et al.,[61] in 1959, in studying the dietary habits and dental caries experience of 200 children,

found very little correlation between the total number of equivalent teaspoons of sugar consumed and DMFS (decayed, missing and filled surfaces). There was also very little relationship between the frequency of eating and DMFS; however, consumption of sugar between meals showed high positive correlation with the DMFS. The mean DMFS of girls was higher than the mean DMFS of the boys, but it was not statistically significant. A significant difference was found in the DMFS rate of city children (mean 6.9) compared to the DMFS rate of rural children (mean 4.92).

Weiss and Trithart,[62] in 1960, conducted a study on preschool children between the ages of 62 and 78 months and demonstrated a definite relationship between the frequency of between-meal eating and caries experience. They found that most between-meal items were high in sugar content and in their adhesiveness. In descending order of popularity, the five most often selected between-meal items were gum, candy, soft drinks, pastries, and ice cream. The average frequency of between-meal eating was 1.75 items per day, and the average number of def (decayed, exfoliated or filled deciduous teeth) was 5.88. This study clearly demonstrated

that as the frequency of between-meal eating increased, a corresponding increase was noted in the number of def teeth per child. The children who did not eat between meals exhibited a def of 3.3 teeth per child; children who ate two items exhibited 5.7 def teeth per child, and children who ate four or more items exhibited 9.8 def teeth per child.

Templeman,[63] in 1964, investigated restricting carbohydrate intake as a means of controlling dental caries. Each subject was placed on a carefully controlled program of carbohydrate intake for six weeks. Throughout the study, between-meal eating was prohibited. The lactobacillus counts were utilized to determine the effectiveness of this diet. A majority of the 127 patients participating in this study were children. Of this number, 80 (65 per cent) benefited from this controlled dietary program and showed definite improvement in their dental health.

Effect of nutrition and diet on periodontal tissues. Since the periodontal tissues are forever in a state of metabolism and constantly in contact with food, it is not difficult to understand that both systemic and local dietary conditions can greatly affect these tissues.

Schour and Massler[64] have referred to the oral

tissues as the "barometer of the state of nutrition of the body." They further stated that the routine examination of the teeth, the gingiva, the tongue, the lips and the saliva at periodic intervals is a simple and fairly accurate method of determining the nutritional status of both the child and the adult. Past nutritional conditions can be determined in the enamel and dentin, and the present status may be observed in the alveolar bone, gingiva and the tongue.

Studies have shown that nutritional deficiencies can affect the periodontal tissues in many ways. Boyle[65, 66] observed atrophic alveolar bone and hyperkeratinization of the gingival crevice epithelium in vitamin A deficiency. Beck et al.[67] showed extensive destruction of the periodontium in dogs deficient in nicotinic acid. Afonsky[68] reported on non-specific gingivitis in vitamin B complex deficiency. Boyle,[69] in 1937, and Glick,[70, 71] in 1949, associated various forms of periodontal disease with vitamin C deficiency.

Waerhaug[72] also reported on the effect of C-avitaminosis on the supporting structures of the teeth. In his study, the histologic picture of the vitamin C deficient periodontal tissue did not resemble that of periodontal disease in man. However, it clearly

demonstrated the abnormal formation of bone, destruction of collageneous fibers, increased osteoclastic resorption and capillary bleedings in vitamin C deficiency.

Stahl,[73, 74] in 1955, demonstrated pronounced periodontal destruction in rats deprived of protein. This was particularly so in the presence of local irritants. Later, in 1963, he reported on the healing of gingival wounds in female rats placed on low protein diets. Histologic observations revealed that the protein deficient rats had more persistent inflammation of the wound and delayed crestal osteogenesis.

Burket,[75] however, felt that many of the deficiency conditions reported in the literature are conditions of severe nutritional deficiency which are not commonly experienced by man. He reported that nutritional disorders, particularly of the chronic and mild nutritional deficiency type rather than the severe acute deficiency type, are the most important group of systemic diseases which may affect the periodontal tissues in man.

Chilton[76] reported that it is very uncommon to find periodontal lesions not being accompanied by local factors, mainly poor dietary habits. However,

physicians, nutritionists and even some dentists attempt to treat periodontal conditions by merely prescribing vitamin supplements, and completely ignoring the local factors. It is important to understand that the correction for nutritional inadequacy should always be accompanied by the knowledge and skill of the dentist in removing the local causative factors in the treatment of periodontal conditions.

Kreshover,[77] in 1956, reported that Americans are over-medicating themselves with vitamin supplements which are readily available over drugstore counters. This may create neglect, as well as carelessness in selecting essential foods and may also initiate toxicity. He further reported that an average healthy person can meet his nutritional requirements easily by ingestion of a variety of readily available foods. Vitamin supplements must be used judiciously in the treatment of periodontal conditions.

Many local factors have also been considered responsible for periodontal conditions. Studies have shown that the consistency of the diet, or its physical form, can affect the periodontal health of man. In 1939, Burwasser[78] demonstrated the effect

of hard and soft diets on the gingival tissues of dogs. Pathological changes in the gingivae were observed in dogs placed on a soft diet. It was assumed that the changes were due to a lack of stimulation, leading to poor circulation and a softening of the gingival tissues.

Haber,[79] in 1940, reported that hard bread can stimulate mastication and increase secretion of saliva, consequently preventing or arresting caries and tartar formation.

Similar results were obtained in a dietary study conducted by Pelzer.[80] Subjects consuming a soft and non-detergent diet were compared with subjects using a hard and detergent diet. A soft diet was found to promote mucoid and calculary deposition on the tooth surface and, because of the lack of stimulation, marginal gingiva showed signs of inflammation. With the use of gingival capillary microscopy, gingival capillaries were shown to be abnormal in number, distribution and tonus in subjects who consumed a soft and non-detergent diet.

Nutrition and Diet Studies of Children

During early childhood, particularly when growth

and development is rapid, good dietary practice is of the utmost importance to the general well-being of the child. Rust[81] has stated that more eventual health benefits can be realized for the nation as a whole through proper nutrition of the infant and young child than by any other combined efforts of the medical and dental professions. It appears, then, that this is the period when optimum nutritional requirements should be met. Nevertheless, surveys have shown that many children are in a nutritionally inadequate state. Perhaps one explanation for their poor nutritional status is their poor eating habits.

Baldwin[82] interviewed 76 mothers to learn the eating habits of their children. He evaluated each child on three variables: appetite, finicalness, and table behavior. It was found that table behavior and good appetite were very closely related to each other and that without good appetite, there was rarely evidence of good table behavior. Finicalness or fussyness was related more to the home environment than to appetite or table behavior. On each of the variables, a majority of the children were rated "unsatisfactory," and 27 per cent of the children were found to be unsatisfactory in all three factors

simultaneously. Most of the children included in the 27 per cent group were considered as "feeding problems."

Warnick et al.,[83, 84] in 1955, studied the nutritional status of adolescent children from three communities in Idaho. The average intake of nine nutrients per child showed very little variation by community; however, a pronounced difference by sex was noted. Boys consumed more of all the nutrients than did girls. Less than one-half of the Recommended Dietary Allowances for ascorbic acid and vitamin A was supplied in a large number of children. They concluded that these children needed more fruits and vegetables which are high in ascorbic acid and vitamin A value in their diet. When the seven-day food records were evaluated in terms of the basic seven food groups, the average amount of food eaten per person compared well with the recommended amounts of the basic seven, except for fruits and vegetables. Boys consumed more milk, cereals and protein foods than the girls, but there was very little difference in the amount for fruits and vegetables. Both boys and girls were deficient in these food groups.

Eppright and Roderuck,[85, 86] in 1955, found that the diet of Iowa school children showed an inadequate

consumption of calcium, ascorbic acid and vitamin A rich foods. The core of their diets consisted of liberal amounts of meat, potatoes, sweet desserts, table fat, and bread and other cereal foods. In a later study, they reported that by supplementing the diet of Iowa school girls with foods consisting of milk, fruits and vegetables, the diets of almost all of the girls were brought within the limits of 66 to 100 per cent of the Recommended Dietary Allowances for calcium, vitamin A and ascorbic acid.

Dunham,[87] in 1960, conducted a study of the five-day food habits of 165 fifth-grade students. The nutritional adequacy of the diets was analyzed by using the basic seven food groups. The results showed that children from higher socioeconomic levels consumed diets of a better quality than children from lower socioeconomic levels. On the average, only nine per cent of the children were considered to be eating a "good diet." After four months of an intensive nutritional education program by the fifth-grade teachers, a survey of food habits was again made. Results showed that 19 per cent of the children were consuming a "good diet." This study clearly demonstrated the need for a continuing nutritional educational program among our school children.

Wharton,[88] in 1963, evaluated the mean daily intake of 11 nutrients for 421 adolescent boys and girls. The three-day dietary records revealed a low intake of calcium, vitamin A, ascorbic acid and iron.

McDonald's[89] evaluation of 500 children treated at the Indiana University clinic showed that only a small percentage were eating an adequate diet. A majority of the children with an inadequate diet were deficient in the fruits and vegetables group, and at least 50 per cent received an inadequate amount of dairy foods.

Hinton et al.,[90] in 1963, reported on the eating behavior and dietary intake of 140 girls 12 to 14 years of age. Their diets included less milk, fruits and vegetables. The dietary-quality scores in the winter were higher than in the summer. The girls who ate more, whether in snacks or meals, had more adequate diets. They also investigated the psychological, sociological and physiological factors which may influence the selection of a diet of good quality. The factors which had significant relationships were: maturation, overweight, and concern about overweight, family relationships, psychological adjustment, health as a value, knowledge of nutrition and the

enjoyment of food.

Nutrition and Diet of the Cerebral Palsied

Cerebral palsied children have feeding problems which do not normally plague the healthy child. The stretch reflexes of the spastics, the involuntary movements of the athetoids and the disturbances of equilibrium of the ataxics are some of the problems which make eating a difficult task for the handicapped. Many of these children are disabled to an extent whereby they must rely on someone else to feed them. Very often they do not receive adequate amounts of food for normal growth and development.

Perlstein and Barnett[11] reported that any one or combination of factors such as persistent vomiting, difficulty in swallowing, gagging, constipation, excessive gas formation, spasm of muscles of swallowing and psychogenic anorexia due to forced feeding may be cause for difficult feeding in these children.

The various problems and techniques in feeding the cerebral palsied children have been described by Matheny and Ruby,[91] Kerr,[92] and Gory.[93] Matheny and Ruby reported that a cerebral palsied child should

be given extra time to eat his meals. They suggested that a major portion of his dinner be served before the family meal time, thereby insuring time to feed him properly, decreasing the problem of distraction, and giving the feeder a chance to enjoy his meals. Kerr stated that these children should be as comfortable and relaxed as possible during meal time. The person feeding the child should be calm, patient and unhurried, since relaxed environment is essential in proper feeding. Gory recommended increasing the number of meals from three times per day to six times per day for children who are difficult to feed.

Cohn et al.,[94] in 1962, reported that man actually benefits from increasing the frequency of eating. The advantages of increased periodicity of food intake may be threefold: (1) the protein requirement may be decreased; (2) the susceptibility to "metabolic" disease (obesity, atherosclerosis and diabetes mellitus) may be decreased, and (3) "metabolic" diseases may be more effectively treated.

Phelps,[95] in 1951, pointed out that the energy needs of children with cerebral palsy differ from those of normal children, since the muscular handicap may either increase or decrease physical activity. Phelps recommended division of cerebral palsy

victims into five general types in considering individual dietary problems:

1. Spastic paralysis--Spastics are not able to control their movements; as a result, they tend to sit most of the time and to be rather lazy. Therefore, their caloric requirements are low.
2. Athetosis--This condition is the opposite of spastic. Athetoid children are constantly in motion and they burn up energy rapidly. There is no problem of obesity in the athetoid group; instead they are usually too thin. Because of this "burning up" of tremendous quantities of food products, it is important to see that they have a good backlog of all of the necessary vitamins.
3. Ataxia--Because of balance loss, they tend to fall in a group who become overweight as a result of inactivity.
4. Rigidity--Muscles of the "rigidities" have a lead-pipe-like rigidness and their response to movement is very slow. Chewing may be so slow that they may take a very long time to eat their meals; many times

they do not finish. Overweight is of no problem in this group.

5. Tremor--This is a rare group of cerebral palsy, and Phelps made no reference to their dietary problems.

Since the five types of cerebral palsy vary in dietary and nutritional requirements, Phelps stated that it is impossible to set up a single diet for the entire group. They should at least be separated into the spastics and athetoids.

Peeks and Lamb,[96] in 1951, studied the dietary practices of 29 cerebral palsied children, predominantly athetoids. Records of food intake kept for one week by the mothers showed that approximately two-thirds of the diets provided 90 per cent or more of the Recommended Dietary Allowances. However, less than half of the subjects were consuming enough food to meet 90 per cent of the caloric and calcium requirements. They found that the relationship of nutrient intake was more directly related to individual pathologic, complications and degree of involvement than to any other factor. It was also found that among the 37 types of foods listed, 77.5 per cent were liked and eaten and 22.5 per cent were disliked and not eaten.

Album,[5] in 1952, reported that malnutrition and vitamin deficiencies are frequently present in the cerebral palsied children. Lack of muscle control can create problems in deglutition and speech. Children thus affected will require a liquid or soft diet which must be maintained throughout their lives. Such a diet is often inadequate in vitamins and minerals and will lead to many metabolic disturbances, including the morphologic abnormalities detected in the dentition of the children.

Leamy,[97] in 1953, conducted a study of a 48-hour food intake of 21 cerebral palsied children and compared their food intake to the recommended allowances for normal children set forth by the National Research Council. Her study revealed that 18 of the 21 handicapped children received inadequate calories. Consumption of the following nutrients, in the order listed, was found to be lower than the recommended allowances: iron; niacin; ascorbic acid; protein; calcium; vitamin A, and thiamine. Leamy found no significant differences between the caloric intake of athetoids and that of spastics.

Album,[98] in 1957, observed gingivitis in a very high percentage of cerebral palsied and mentally retarded children. Clinical observations of 119 children

showed that adequate intake of vitamin B and C greatly improved the gingival conditions. He reported that, after vitamin therapy, the gingival tissues appeared firmer, more pink in color and healthier.

Sterling,[99] in 1960, studied the height and weight of 100 cerebral palsied children. Children with cerebral palsy, compared to their siblings or to the standard anthropometric charts, showed smaller measurements in both height and weight. The following factors were pointed out as possible explanations for their retarded growth: (1) damage to growth centers; (2) malnutrition and undernourishment due to difficulty in feeding, and (3) metabolic needs may be greater in some cerebral palsied children.

Tobis et al.,[100] in 1961, studied the growth pattern of 86 cerebral palsied children. Heights and weights of the subjects were also found to be significantly below the norms used and significantly lower than the non-handicapped children of the same age, sex, ethnic origin and geographic area. Similar explanations to those of Sterling's were discussed as possible causes for the retarded growth.

Karle et al.,[101] in 1961, evaluated the nutritional status of 12 cerebral palsied children between

the ages of two and 10 years. The amount of hemoglobin and serum concentration of vitamin A, carotine, and ascorbic acid were determined at regular intervals over a five-month period. Blood samples were obtained from each subject before the study was begun and then at regular intervals throughout the study. These children appeared to be well nourished according to the biochemical findings; however, in several instances, dietary records indicated deficiencies in iron and protein. Although the caloric consumption was less than the recommended allowance for those children according to their ages, Karle and her associates did not suggest that all cerebral palsied children be urged to increase their caloric intake.

Ruby and Matheny,[102] in 1962, evaluated the growth pattern of 137 cerebral palsied children between the ages of two and one-half and 18 years and found that growth retardation was common among the handicapped children. The results showed a growth lag of 12 to 15 months for boys and approximately 18 months for girls. The "mouth area" involvement was closely associated with poor food intake, consequently affecting general growth. They stated that these children possessed the following three problems which can lead to poor food intake: (1) mechanical problem

created by poor function of the mouth, tongue and throat makes eating a slow and laborious process; (2) many children tire easily since so much effort is involved in being fed or in feeding themselves, and (3) loss of food during mealtime which is a common problem in these children.

Hammond,[103] in 1963, conducted a nutrition study of 31 cerebral palsied children from seven to 16 years of age. Her study included 11 girls and 20 boys; 26 spastics and five athetoids. The intelligence quotient scores ranged from below 19 to above 50. In assessing the nutritional status of these children, six-day dietary records were obtained and blood samples were biochemically analyzed.

In discussing the individual diets of 33 children, Hammond classified seven diets "good" (intake of 100 per cent or more of the allowances), three diets "poor" (intake of less than 67 per cent of the allowances), and the remaining diets "fair" (intake of 67 to 99 per cent of the allowances). Over half of the children did not meet 100 per cent of the allowances for calories, calcium, iron and thiamine. However, the group picture was not markedly different from that of the healthy children. Caloric intake of the athetoids was greater than that of the

spastics. Subjects with lesser arm involvement had higher caloric intake than those with greater arm involvement. Hammond also found that mental retardation affected the dietary intake. Subjects with greater mental retardation had lesser dietary intake, and less retarded individuals had greater dietary intake.

STATEMENT OF PROBLEM

The purpose of the study was to investigate the dietary habits of cerebral palsied children. Because of their physical conditions, these children exercise only a limited degree of choice in food selection. For many of them, eating is a difficult task and management of some foods is practically impossible.

This study was conducted to learn if the nutritional adequacy, the consistency of the diet, the number of meals per week, and the frequency and types of between-meal snacks were affected by the disability due to the disease. To accomplish this, each child was classified into physiological, topographical, functional capacity and mental retardation classifications in order to describe the extent to which the child was afflicted by the disease.

EXPERIMENTAL PROCEDURE

The diets of 30 cerebral palsied children two and one-half to 13½ years of age were studied. The children attended the Cerebral Palsy Clinic at the Indiana University Medical Center between October, 1964 and February, 1965. A complete medical history was available for each child.

Parents of 57 cerebral palsied children were given seven-day diet survey sheets.* Thirty diet surveys were completed and returned. Identical instructions for recording the diet were given to the parents. The parents were told to record only those foods which were actually consumed. They were asked to describe all foods in detail, quantity consumed and the method of preparation.

Each child was classified into physiological, topographical, functional capacity and mental retardation classifications in order to describe the extent to which the child was afflicted by the disease.

The physiological, topographical and functional capacity classifications described by Minear[15] were modified slightly for this study as follows:

Physiological classification was based on the motor symptoms.

1. Spasticity--Characterized by a lower threshold

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* Modified from diet survey form recommended by Martin.[104]

of the stretch reflex, an enlarged reflexogenic area, augmented responses with clonus, and an abnormal electromyographic record.

2. Athetosis--Characterized by abnormal amount and type of involuntary motion, normal reflexes, normal electromyograhic findings, uncontrolled, involuntary and inco-ordinate motions with varying degrees of tension or non-tension.
3. Rigidity--A disturbance of the agonist-antagonist relations with resistance to slow passive motion of both agonist and antagonist muscles. If the resistance to passive motion is continuous, it is referred to as the "lead-pipe" rigidity--if discontinuous, "cog-wheel" rigidity.
4. Ataxia--Ataxia is primary inco-ordination due to disturbance of kinesthetic or balance sense, or both.
5. Tremor--Which may be intentional, non-intentional or constant, uncontrollable, involuntary motions of a rhythmic, alternating, or pendular pattern due to alternate agonist and antagonist contractions.
6. Atonia--Lack of tone, and failure of muscle

to respond to volitional stimulation.

7. Mixed--Any combination of two or more of the above conditions.
8. Unclassified.

Topographical classification was based on the topographical distribution of the involvement.

1. Monoplegia--Rare condition involving one limb only.
2. Paraplegia--Condition involving legs only and almost always of the spastic or rigidity type.
3. Hemiplegia--Condition involving lateralized one-half of the body and it is usually spastic, although pure athetoid hemiplegias are occasionally seen, as are pure rigidity hemiplegias. There is often sensory involvement in the area of proprioception to point discrimination and form perception.
4. Triplegia--This condition involves three extremities, usually both legs and one arm, and usually spastic, and patients with greatest involvement of the arms are usually the dyskinetics, including athetoids.
5. Quadriplegia--Involvement of all four extremities to an equal degree.

6. Diplegia--Bilateral paralysis or paralysis affecting like parts on either side of the body (According to Perlstein,[9] diplegia is a condition involving the legs primarily and the arms to a slight extent. Cases of this type are generally of the spastic variety).
7. Double Hemiplegia--This term is seldom used. Those cases in which the arms are more involved than the legs.

Functional Capacity classification has to do with the degree of severity of the disease.

1. Class I--Patients with cerebral palsy with no practical limitation of activity.
2. Class II--Patients with cerebral palsy with slight to moderate limitation of activity.
3. Class III--Patients with cerebral palsy with moderate to great limitation of activity.
4. Class IV--Patients with cerebral palsy unable to carry on any useful physical activity.

Mental retardation classification was based on the Measured Intelligence Levels which were described by Heber.[16]

1. Level V--Borderline retardation of Measured Intelligence--I. Q. range of 68-83 (SBT)* and of 70-84 (WISC).⁄
2. Level IV--Mild retardation of Measured Intelligence--I. Q. range of 52-67 (SBT) and of 55-69 (WISC).
3. Level III--Moderate retardation of Measured Intelligence--I. Q. range of 36-51 (SBT) and of 40-54 (WISC).
4. Level II--Severe retardation of Measured Intelligence--I. Q. range of 20-35 (SBT).
5. Level I--Profound retardation of Measured Intelligence--I. Q. range of 0-20 (SBT).
6. Normal

The investigator and the Co-ordinator of the Indiana University Cerebral Palsy Clinic reviewed the medical records for each child included in this study. Each child was classified in both the physical and mental classifications defined above (Table II, III, IV and V).

The dietary evaluation was conducted in the following manner for each child individually, for all of

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* SBT--Stanford-Binet Test

⁄ WISC--Weshsler Intelligence Scale for Children

the children as a group, and for each group of children in the preceding classifications:

1. Assessment of nutritional adequacy. To assess the nutritional adequacy of the diet, each seven-day food record was analyzed to determine the number of servings of foods consumed per week in each of the four food groups (milk, meat, vegetable-fruit, and bread-cereals) as recommended by the Agricultural Research Service of the United States Department of Agriculture.[105] The minimum recommended amount of the four food groups as specified by the Agricultural Research Service is as follows:* (1) Milk group--21 servings (one serving is equivalent to eight ounces of whole milk) per week for all children in the study except one (MM) whose minimum recommended amount was 28.[/] (2) Meat group--14 servings (one serving is equivalent to two ounces of lean meat) per week for all children in the study. (3) Vegetable-fruit group--28 servings (one serving is equivalent to one-half cup of fruits and/or vegetables)

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* Since the recommended amounts are expressed in terms of one day's food consumption, multiplying these amounts by seven provided the recommended amounts for one week.

[/] The recommended number of servings of milk increases from three servings per day to four servings per day at the age of 13.

per week for all children in the study. (4) Bread-cereals group--28 servings (one serving is equivalent to one slice of bread) per week for all children in the study.

The amount of nutrients* contained in a diet was calculated according to the number of servings of food consumed in each of the four food groups. The average quantity of nutrients provided by the minimum number of servings from each food group is given in Table 6 of the Essentials of An Adequate Diet.[105] This table was interpolated to establish the nutrient content of a serving of food in each of the four food groups (Table VIII). In addition, the caloric contents of those foods not included in the four food groups analysis were included in the nutrient evaluation. Specific examples of those foods are carbohydrates and fats. The food values established by Bowes et al.[106] were utilized to determine caloric values. The actual amount of each nutrient consumed was expressed in terms of percentage of the Recommended Dietary Allowances,[107] specified by the Food and Nutrition Board for normal children of same sex and chronological age (Tables X and XI).

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* The term nutrients as used in this study includes calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid.

The Food and Nutrition Board specified the allowances only for children of ages 2, 3½, 7½, 10½ and 13½ years; thus, it was necessary to estimate the allowances for the intermediate ages (Table IX).

2. Consistency of diet. The consistency of the diet was evaluated in a manner similar to that proposed by Nizel[108] in evaluating the diets of patients with periodontal disease (Figure 2). Each food item was classified as either hard or soft. A ratio of soft to hard was determined; this ratio was expressed as the consistency index. The index was used to study the consistency of the diet for each child in the study (Tables XII and XIII).

3. Number of meals per week. The average number of meals per week for each child was determined (Tables XII and XIII). Foods consumed during between-meal periods as well as meal periods which were of a quantity similar to that of an average meal were considered a meal.

4. Frequency of between-meal snacks. The frequency of between-meal snacks, in terms of the number of items eaten per week was analyzed for each child (Tables XII and XIII). All items eaten between breakfast, lunch and dinner including those eaten before breakfast and after dinner were considered between-meal

items. Some of these same snacks were also considered meals in calculating the number of meals per week. A subject consuming a same snack item at two different periods was tabulated as having two separate items. Similarily, a subject consuming two different items in a same snack period was tabulated as having two separate items. Desserts such as cakes, pies, cookies and even candies eaten with a meal were not considered as between-meal items.

5. Types of between-meal snacks. In order to study the types of between-meal snacks, each item was listed and tabulated in the order of popularity (Table XIV).

This study was limited solely to the dietary habits of cerebral palsied children. No attempt was made to relate the results of the dietary study to the oral and dental status nor was there an attempt made to ascertain why the findings differed from those recommended by the Agricultural Research Service[105] and the Food and Nutrition Board.[107]

DATA

Diets of 30 cerebral palsied children, two and one-half to 13½ years of age, were studied. The following five factors were evaluated in order to assess their dietary habits and to determine how much these were affected by their disablement: (1) nutritional adequacy of diet; (2) consistency of diet; (3) number of meals per week; (4) frequency of between-meal snacks, and (5) types of between-meal snacks.

Nutritional Adequacy of Diet

Tabulation of dietary intakes in terms of the four food groups revealed that no child in the study consumed 100 per cent or more of the recommended amount of servings in all four groups simultaneously. The bread-cereals group was the food group in which the children had the best intake; the meat group was second in consumption, the milk group third, and the greatest deficiency was found in the vegetable-fruit group.

The consumption of food in the milk group ranged from 38 to 150 per cent of the recommended number of servings. The mean* milk consumption was 78 per cent.

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* For the tabulation of mean percentage intakes, all intakes in excess of 100 per cent of the allowance were considered as 100 per cent intake.

Twenty children consumed over two-thirds of the recommended amount. One child (TR) consumed 150 per cent of the recommended amount of milk. This was unusual, however, since the second highest milk consumption was only 119 per cent.

One 8½-year-old child (JJ) consumed only 38 per cent of the recommended amount of milk per week. This item was substituted by such beverages as Kool-Aid, water and soft drinks which are of practically no nutritional value. A 10-year-old child (JT) consumed only 44 per cent of the recommended number of servings of milk. His one-week diet record revealed a consumption of seven servings of soft drinks, seven cups of coffee, and nine cups of tea. In most instances, milk could have been substituted very easily for these beverages.

On the basis of the physiological classification, consumption of milk by the spastic children was significantly lower than in the other types of cerebral palsy. The mean intake of milk by the spastics was 68 per cent of the recommended amount. Atonic and athetoid children showed best milk intake (87 per cent and 85 per cent respectively). According to the topographical classification, quadriplegic children had the best milk consumption, 83 per cent of the

recommended amount, and diplegics consumed the least amount, 71 per cent.

The mean intake of meat among the cerebral palsied was 80 per cent of the recommended amount. The meat intakes ranged from 32 to 177 per cent; however, 24 of the 30 children consumed meat within the range of 67 to 111 per cent. Only two children had a consumption above this range and four were below.

The dietary record of a six-year-old athetoid diplegic female (LT) showed only 32 per cent consumption of the recommended amount of meat. The dietary intake of this child was inadequate in all four food groups. Her consumption of food in the vegetable-fruit group was also the lowest among the cerebral palsied children.

According to the physiological classification, spastic children had the best meat consumption. Mixed children consumed 82 per cent; athetoids consumed 77 per cent, and atonics consumed 76 per cent. On the basis of the topographical classification, both paraplegics and hemiplegics had good meat intake (100 per cent and 93 per cent, respectively). Diplegics had the lowest consumption (74 per cent), followed closely by quadriplegics (79 per cent).

Fruits and vegetables were the least popular

foods among the cerebral palsied children. The mean intake of foods in vegetable-fruit group was 61 per cent; the intake ranged from 14 to 127 per cent of the recommended amount. Only three children consumed over 100 per cent; 18 of the 30 children consumed less than two-thirds of the recommended amount.

According to the physiological classification, the spastic children, with 68 per cent intake, was the group with the highest consumption of fruits and vegetables. Mixed children consumed 58 per cent; athetoid children consumed 55 per cent, and atonic children consumed 49 per cent. On the basis of the topographical classification, paraplegics were the only children with a consumption of over two-thirds of the recommended amount.

The percentage consumption of food in the bread-cereals group ranged from 35 to 202. Consumption of foods in this group was either too excessive or too deficient; only two children consumed bread and cereals within the range of 90 to 110 per cent. Eleven children were above and 19 children were below the 100 per cent level. The mean percentage consumption was 84.

According to the physiological classification, athetoid children consumed the greatest amount of

bread and cereals. Five of the eight athetoid children consumed above 100 per cent of the recommended amount; the mean intake among the athetoids was 89 per cent. Hemiplegics had the highest consumption (91 per cent) of bread and cereals by topographical classification; five of seven hemiplegic children consumed above the 100 per cent level.

It was difficult to assess the dietary habits according to the degree of physical involvement (functional capacity classification) due to the uneven distribution of the samples. However, mean intakes in each category of physical involvement were recorded (Table VII).

The degree of mental retardation (mental retardation classification by Measured Intelligence Levels), did not reveal any definite pattern in the children's dietary intake (Table VII).

When the diets were analyzed in terms of nutrient contents, the cerebral palsied children showed adequate intakes in riboflavin, protein, vitamin A and thiamine with their mean intakes of 97, 96, 95, and 94, respectively. Seventeen children met 100 per cent or more of the allowances for the above four nutrients simultaneously. There were no significant variations in the consumption of these nutrients according to

the different types of cerebral palsy.

The greatest nutritional deficiencies were shown in iron, calories and niacin with their mean percentage intakes of 67, 69, and 69, respectively. Intakes of these three nutrients were low in all children to an approximately equal degree. Caloric consumption ranged from 41 to 108 per cent with 19 of 30 children, and most of them just barely, meeting two-thirds of the recommended allowances. Atonic children had the highest caloric consumption. Mixed and athetoid children consumed more calories than did the spastics. On the basis of the topographical classification, quadriplegics consumed the highest amount of calories; however, the differences among the four types were very slight.

The percentage range of iron consumption was 33 to 99, and of niacin consumption was 33 to 97. Two-thirds of the recommended allowances for iron was met by 16 children and for niacin, by 19 children. Mixed children had the best iron consumption; however, the differences among the types of cerebral palsy were not significant. Niacin was consumed almost equally by the various cerebral palsy groups.

The percentage consumption of ascorbic acid ranged from 24 to 168 with its mean intake at 78.

Thirteen diets exceeded the recommended level; nevertheless, some severe deficiencies of ascorbic acid were noted. Ten children did not meet two-thirds of the allowances.

The percentage intake of calcium ranged from 47 to 151 with its mean intake at 84. Ten children exceeded 100 per cent or more of the allowances for calcium; five children did not meet two-thirds of the allowances.

There was no definite trend shown in the nutrient consumption according to the degree of severity; neither did the nutrient intake vary significantly according to the intelligence levels. Vitamin supplements were taken regularly every morning by three children (CMG, MST and TR), but vitamins were not included in the analysis of the nutrient contents of the diet.

Consistency of Diet

The total number of servings of soft food divided by the total number of servings of hard food indicated the consistency of the diet. Thus, if a diet consisted of more soft food than hard food, the number was greater than one. This number for all cerebral palsied children ranged from 0.99 to 4.45; the mean was 1.78 (Table XII). All children except one (KM)

had diets which were soft in consistency.

The athetoids and the spastics consumed foods which were softer than those of mixed and atonic children (Table XIII). According to topographical classification, hemiplegics had the softest form of diet. There was no relationship between the consistency of the diet and the degree of physical (functional capacity classification) and mental (mental retardation classification) disability.

Number of Meals per Week

The cerebral palsied children consumed an average of 19.6 meals per week. Their meal consumption ranged from 12 to 23 per week (Table XII). Breakfast was missed the most number of times (21 per week) by eight children; 10 children missed 19 lunches per week, and six children missed seven dinners per week.

Seven between-meal eatings were of sufficient quantity to be considered meals. They consisted of sandwiches and beverages. Five were eaten between lunch and dinner and two were eaten after dinner.

The greatest number of meals was missed by spastic children; there was very little difference in the number of meals consumed between athetoid, atonic and mixed children (Table XIII). According to topographical classification, paraplegic and diplegic

children missed the most number of meals (18.0 and 18.1 meals consumed per week). There was no relationship between the number of meals consumed per week and the degree of physical and mental disability.

Twelve quadriplegic children had a mean intake of 20.8 meals per week. Nine of the 12 did not miss a single meal, and the remaining three missed only one meal per week per person.

Only three of the 30 cerebral palsied children missed meals to a significant extent: (1) A six-year-old female (LI) consumed only 12 meals per week. Her dietary record revealed that lunch was never eaten, and her diet was found to be the poorest of all the cerebral palsied children. (2) An 11-year-old male (DV) consumed only 13 meals during the week of the survey; he missed six breakfasts. (3) A five-year-old male (JH) missed six meals during one week; an excessive consumption of between-meal snacks was substituted for his meals.

Frequency of Between-Meal Snacks

Frequency of between-meal snacks was evaluated by the number of between-meal items consumed per week. The between-meal eating ranged from zero to 54 items per week. The mean consumption was 19.6 items per week (Table XII).

Diplegics consumed more between-meal items than any other group of cerebral palsy; the degree of physical disability had some relationship to the frequency of between-meal items (Table XIII). More severely affected children generally consumed more items between meals than less severely affected children. There was no relationship between the degree of mental retardation and the frequency of between-meal snacks.

Types of Between-Meal Snacks

All items consumed between meals were catagorized into 26 types of snacks. Milk was consumed by the most number of subjects, 99 times for 24 children. The second most popular item was candy. Twenty children consumed 109 candies. More children consumed milk than candy, but candy was consumed a greater number of times than milk. In a similar manner, more children consumed soft drinks than cookies, but cookies were eaten more than twice as many times as soft drinks (Table XIV).

It was interesting to note that so many children ate fresh fruits for between-meal snacks. Fifteen children ate 54 servings of fresh fruits and two servings of raw vegetables. Apples were the most popular, and many children had oranges and bananas

for snacks. Even with such a good consumption of fruits and vegatables, these children still showed deficiency of foods in the vegetable-fruit group.

FIGURES AND TABLES

Figure 1. A sample form used for recording the seven-day dietary intake of the child by the parents.

Figure 1

NAME_____ AGE_____

SEX_____ WEIGHT_____ HEIGHT_____

INSTRUCTIONS

1. Please keep an accurate record of all foods the child eats for a period of seven days.
2. This includes everything that he puts into his mouth and swallows. Do not record foods which he spits out.
3. List foods as soon after eating as possible, preferably at the table.
4. Designate kind of food eaten, how prepared and amount eaten.
   A. Kind of food eaten: Example--not cake but chocolate cake with white icing.
   B. How prepared: Example--not potatoes but mashed potatoes; not carrots but buttered slices.
   C. Amount: Example--not serving but 1/2 cup, number of tablespoons or ounces.
5. Include all "extras": snacks, butter, jelly and jam for bread, dressings for salads, etc.
6. List separately the different foods that compose one diet item, such as the "make up" of a hamburger sandwich (see example on page 2).

SAMPLE--ANYDAY

AMOUNT	FOOD		MONDAY AMOUNT	MONDAY FOOD
BREAKFAST				
1 c.	milk			
3/4 c.	corn flakes			
2 tsp.	sugar	record all extras		
1/2 c.	milk			
2 sl.	toast			
	butter			
	grape jelly			
MORNING SNACK				
	None			
LUNCH				
1-1/2	hamburger	describe "make-up"		
	bun	of hamburger		
	ground beef			
	catsup			
	relish			
1 c.	potato chips	indicate if bever-		
6 oz.	cola drink	age is sugar-free		
1/2 c.	baked beans	(low calorie type)		
AFTERNOON SNACK				
1 c.	milk			
3 pcs.	chocolate chip cookies	list all snacks		
DINNER				
1 serv.	meat loaf	use "serving" only		
1 med.	baked potato	when absolutely		
	butter	necessary		
	bacon			
1/2 c.	green beans			
	butter			
1-1/2c.	milk			
1 sl.	apple pie			
EVENING SNACK				
1 cake	cupcake	describe kind of		
1 bar	Hershey choc. with almonds	food eaten		
6 oz.	cola drink			

	TUESDAY		WEDNESDAY		THURSDAY
AMOUNT	FOOD	AMOUNT	FOOD	AMOUNT	FOOD
BREAKFAST					
MORNING SNACK					
LUNCH					
AFTERNOON SNACK					
DINNER					
EVENING SNACK					

FRIDAY		SATURDAY		SUNDAY	
AMOUNT	FOOD	AMOUNT	FOOD	AMOUNT	FOOD
	BREAKFAST				
	MORNING SNACK				
	LUNCH				
	AFTERNOON SNACK				
	DINNER				
	EVENING SNACK				

Figure 2. A sample form used to interpret the dietary intake of the child. The analyses for number of servings of food in each of the four food groups, number of between-meal items, physical form of the diet, and number of meals per day were made in this form.

FOOD GR.	Physical Form	MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.	Total/ Week	Rec. Week	Diff.
MILK	Liquid Soft										
	Hard										
MEAT	Soft Chopped										
	Solid										
FRUITS and VEGE-TABLES	Juice Processed										
	Raw, Firm Part Cooked										
BREAD CEREAL	Soft Cooked										
	Dry, Crusty Toasted										
Total #	Between-meal items										
Total #	Soft										
Total #	Hard										
Total #	Meals										
SUGAR and SWEET	Solution										
	Retentive Sweet										
	Solid Sweet										

Figure 2

Figure 3. A sample form used to convert the amount of food consumed into the amount of calories and nutrients.

Figure 3

FOOD GR.	Dif/wk. /	Dif/day /	Calor. Cal.	Prot. Gm.	Cal. mg.	Iron mg.	Vit. A I.U.	Thia. mg.	Ribo. mg.	Niac. mg.	Asc. A. mg.
MILK											
MEAT											
FRUITS and VEGS.											
BREAD and CEREALS											
TOTAL DEFICIENCY											
EXCESS											
Amount of Nutrients Furnished by Daily Food Plan with											
TOTAL Actual amount consumed											
Amount of calories from sugar and sweets											
Recommended Dietary Allowances, 1963											
% of R.D.A. consumed											

Table I. Data concerning the subjects in this study.

TABLE I.

Name	Age	Sex	Physiological	Topographical	Functional Capacity Class	Measured Intelligence Levels
CMG	2½	M	Mixed	Diplegic	II	IV
SH	3½	F	Athetoid	Quadriplegic	II	Normal
KM	4	F	Mixed	Quadriplegic	IV	V
CMH	4	M	Atonic	Hemiplegic R	I	IV
SR	4	F	Spastic	Diplegic	II	IV
CF	4	M	Athetoid	Quadriplegic	III	V
JA	4½	M	Mixed	Quadriplegic	IV	I
JH	5	M	Spastic	Diplegic	II	V
LI	6	F	Athetoid	Diplegic	I	IV
MST	6	F	Mixed	Quadriplegic	I	Normal
JS	6	F	Spastic	Diplegic	I	V
MS	6	M	Mixed	Quadriplegic	I	Normal
CM	6½	F	Atonic	Quadriplegic	II	III

TABLE I. (continued)

Name	Age	Sex	Physiological	Topographical	Functional Capacity Class	Measured Intelligence Levels
CN	7	F	Spastic	Hemiplegic R	I	II
JG	7½	F	Spastic	Paraplegic	I	III
LH	7½	M	Athetoid	Quadriplegic	II	IV
DMC	7½	M	Mixed	Diplegic	II	IV
DB	8	F	Mixed	Diplegic	II	IV
LW	8	M	Spastic	Hemiplegic R	I	IV
TR	8½	M	Athetoid	Quadriplegic	I	IV
JJ	8½	F	Spastic	Diplegic	I	IV
RGM	8½	F	Athetoid	Quadriplegic	II	III
JB	10	M	Spastic	Paraplegic	II	V
JT	10	M	Spastic	Hemiplegic L	II	II
RVC	10	F	Spastic	Diplegic	II	III
DV	11	M	Mixed	Hemiplegic R	I	Normal
RC	11½	M	Spastic	Hemiplegic L	I	Normal
CL	12	M	Mixed	Quadriplegic	II	IV
MM	13½	F	Athetoid	Quadriplegic	III	IV

TABLE II.

Physiological classification	No. of children
Spastic	11
Mixed	9
Athetoid	8
Atonic	2

TABLE III.

Topographical classification	No. of children
Quadriplegic	12
Diplegic	9
Hemiplegic	7
Paraplegic	2

TABLE IV.

Functional capacity classification	No. of children
Class I	13
Class II	13
Class III	2
Class IV	2

TABLE V.

Mental retardation classification	No. of children
Normal	6
Level V	5
Level IV	12
Level III	4
Level II	2
Level I	1

Table VI. Dietary intakes of all children in terms of number of servings consumed in each of the four food groups.

TABLE VI.

Subject	Age yrs.	MILK		MEAT		FRU and VEG		BRE and CER	
		No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount
CMG	2-1/2	19-1/4	92	11	79	22-1/2	80	25	89
SH	3-1/2	12-3/4	61	7	50	21-1/2	77	26	93
KM	4	9-1/2	45	11-1/4	81	7-3/4	28	21-3/4	78
CMH	4	15-1/2	74	10-3/4	77	14-3/4	53	18-1/4	65
SR	4	10-1/2	50	10-1/4	74	7-1/2	27	17-1/2	63
CF	4	17-3/4	85	7-1/4	52	8-3/4	31	14-3/4	53
JA	4-1/2	21	100	10-1/4	74	20-1/4	73	9-3/4	35
JH	5	17	81	10-3/4	77	17-1/2	63	25	89
LI	6	13	62	4-1/2	32	3-3/4	14	18-3/4	67
MST	6	12	57	8-1/2	61	13-3/4	49	21	75
JS	6	14-1/4	68	11	79	21-1/2	77	20	72
MS	6	12-1/2	60	9-1/4	67	25-3/4	92	24-1/2	88
CM	6-1/2	22-1/4	106	10-1/2	75	12-1/2	45	21-3/4	78

TABLE VI. (continued)

Subject	Age yrs.	MILK		MEAT		FRU and VEG		BRE and CER	
		No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount
CH	7	16-1/4	78	13	93	21-1/2	77	32-1/2	116
CN	7	21-1/4	102	11-1/2	82	29	104	20-1/2	73
JG	7-1/2	16-3/4	80	14	100	12-1/2	45	14	50
LH	7-1/2	18	86	15	107	10	36	31	111
DMC	7-1/2	21	100	13-1/2	97	19-3/4	71	45-1/2	162
DB	8	19-1/2	93	10-3/4	77	10	36	24-1/2	88
LW	8	13	62	15	107	17-1/2	63	41-1/4	148
TR	8-1/2	31-1/2	150	14	100	26-1/4	94	38-1/2	137
JJ	8-1/2	8	38	11	79	29-3/4	106	24	86
RGM	8-1/2	22	105	12-1/2	89	15-1/2	55	38	136
JB	10	15-3/4	75	15-1/2	111	35-1/2	127	26-1/2	95
JT	10	9-1/4	44	14	100	7-3/4	28	43-1/2	155
RVC	10	12-1/4	57	10	71	24-1/4	87	20-3/4	74

TABLE VI. (continued)

Subject	Age yrs.	MILK		MEAT		FRU and VEG		BRE and CER	
		No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount	No. of servings consumed	% of recom. amount
DV	11	20	95	15-1/4	109	8-1/2	30	33-1/2	1 20
RC	11-1/2	20-1/4	96	16-1/4	116	15	54	44-1/2	159
CL	12	25	119	24-3/4	17.7	18	64	56-1/2	202
MM	13-1/2	32	114	14	100	14-3/4	53	35	125

Table VII. Evaluation of dietary intake according to types of cerebral palsy.

TABLE VII.

Types of Cerebral Palsy	MILK Mean % of rec. amount	MEAT Mean % of rec. amount	FRU & VEG Mean % of rec. amount	FRU & CER Mean % of rec. amount
Physiological				
Spastic	68	87	68	82
Mixed	83	82	58	84
Athetoid	85	77	55	89
Atonic	87	76	49	72
Topographical				
Quadriplegic	83	79	58	83
Diplegic	71	74	62	81
Hemiplegic	77	93	58	91
Paraplegic	78	100	89	73
Functional Capacity				
Class I	75	82	68	83
Class II	80	84	59	90
Class III	93	76	42	77
Class IV	73	78	51	57
Measured Intelligence Levels				
Normal	75	79	63	93
Level V	71	78	60	77
Level IV	80	85	58	88
Level III	84	84	58	76
Level II	72	91	64	87
Level I	100	74	73	35

Table VIII. Amount of Nutrients furnished by the four food groups.

NUTRIENTS FURNISHED BY THE FOUR FOOD GROUPS*

	Calor cal.	Prot Gm	Calc mg	Iron mg	Vit.A I.U.	Thia mg	Ribo mg	Niac mg	Asc.A. mg
MILK									
2 cups	320	16.0	514	0.3	870	0.13	0.69	0.4	trace
3 cups ✣	480	24.0	771	0.45	1305	0.20	1.04	0.6	trace
4 cups ✣	640	32.0	1028	0.6	1740	0.26	1.38	0.8	trace
1 cup = 1 serv ✣	160	8.0	257	0.15	435	0.07	0.35	0.2	trace
MEAT									
4 oz.cooked	405	27.1	47	4.6	930	0.33	0.40	6.0	0
2 oz. = 1 serv ✣	203	13.6	24	2.3	465	0.17	0.20	3.0	0
FRUITS AND VEGETABLES									
¼ cup dark green	25	1.0	23	0.6	2590	0.04	0.04	0.3	13
½ cup citrus fruit	55	0.9	27	0.4	140	0.08	0.03	0.3	53
½ cup other vegetables	80	2.3	22	0.8	80	0.07	0.05	0.9	13
½ cup other fruits	80	0.8	16	0.7	560	0.04	0.05	0.4	7
TOTAL	240	5.0	88	2.5	3370	0.23	0.17	1.9	86
½ cup = 1 serv ✣	60	1.3	22	0.6	843	0.06	0.04	0.5	21.5
BREAD AND CEREALS									
4 slices = 4 servings	290	8.8	55	2.1	30	0.30	0.16	2.5	0
1 slice = 1 serving ✣	73	2.2	14	0.52	8	0.08	0.04	0.6	0
TOTAL AMOUNT OF NUTRIENTS FURNISHED BY: ✣ 3 cups milk 2 serv meat 4 serv fr & veg 4 serv br & cer	1415	64.9	961	9.65	5635	1.06	1.77	11.0	86.0

* Slightly modified from Table 6 of Essentials of an Adequate Diet. Home Economics Research Report No. 3. Agricultural Research Service United States Department of Agriculture.

✣ Estimated amount of nutrients based on Table 6.

Table IX. Recommended Dietary Allowances for ages two to 13½ years.

RECOMMENDED DIETARY ALLOWANCES*

Age yrs.	Calor cal	Prot Gm	Calc mg	Iron mg	Vit.A I.U.	Thia mg	Ribo mg	Niac mg	Asc A. mg
2	1300	32	0.8	8	2000	0.5	0.8	9	40
2½	1360	33.6	0.8	8.4	2100	0.52	0.84	9.4	42
3	1420	35.2	0.8	8.8	2200	0.54	0.88	9.8	44
3½	1480	36.8	0.8	9.2	2300	0.56	0.92	10.2	46
4	1540	38.4	0.8	9.6	2400	0.58	0.96	10.6	48
4½	1600	40	0.8	10	2500	0.6	1.0	11	50
5	1683	42	0.8	10.3	2667	0.63	1.05	11.5	51.6
5½	1767	44	0.8	10.6	2833	0.66	1.1	12.0	53.3
6	1850	46	0.8	11	3000	0.7	1.15	12.5	55
6½	1933	48	0.8	11.3	3167	0.73	1.2	13.0	56.7
7	2017	50	0.8	11.6	3333	0.76	1.25	13.5	58.3
7½	2100	52	0.8	12	3500	0.8	1.3	14	60
8	2150	53.3	0.85	12.5	3667	0.83	1.35	14.3	61.7
8½	2200	54.7	0.90	13.0	3833	0.86	1.40	14.6	63.3
Boys									
9	2250	56	0.95	13.5	4000	0.9	1.35	15	65
9½	2300	57.3	1.00	14.0	4166	0.93	1.36	15.3	66.6
10	2350	58.7	1.05	14.5	4333	0.96	1.38	15.6	68.3
10½	2400	60	1.1	15	4500	1.0	1.4	16	70
11	2500	62.3	1.15	15	4583	1.03	1.46	16.6	71.6
11½	2600	64.6	1.20	15	4667	1.06	1.53	17.3	73.3
12	2700	67	1.25	15	4750	1.1	1.6	18	75
12½	2800	69.6	1.30	15	4833	1.13	1.66	18.6	76.6

RECOMMENDED DIETARY ALLOWANCES*
(continued)

Age yrs.	Calor cal	Prot Gm	Calc mg	Iron mg	Vit.A I.U.	Thia mg	Ribo mg	Niac mg	Asc A. mg
13	2900	72.3	1.35	15	4917	1.16	1.73	19.3	78.3
13½	3000	75	1.4	15	5000	1.2	1.8	20	80
Girls									
9	2200	54.7	0.9	13.0	3833	0.86	1.40	14.6	63.3
9½	2200	54.8	0.97	13.7	3889	0.87	1.30	14.7	65.5
10	2200	54.9	1.03	14.3	3945	0.88	1.30	14.8	67.7
10½	2200	55	1.1	15	4500	0.9	1.3	15	80
11	2250	56	1.13	15	4583	0.91	1.33	15.3	80
11½	2300	57	1.16	15	4667	0.93	1.36	15.6	80
12	2350	58	1.2	15	4750	0.95	1.4	16	80
12½	2400	59.3	1.23	15	4833	0.96	1.43	16.3	80
13	2450	60.6	1.26	15	4917	0.98	1.46	16.6	80
13½	2500	62	1.3	15	5000	1.0	1.5	17	80

*Allowances for ages 2, 3½, 7½, 10½ and 13½ years were established by the Food and Nutrition Board of the National Academy of Sciences--National Research Council under the title Recommended Dietary Allowances, Revised 1963. The intermediate figures were calculated on the basis of the allowances for the above ages.

Table X. Nutrient intakes of all children expressed in percentages of the Recommended Dietary Allowances.

TABLE X.

Subject	Age yrs.	Calo	Prot	Calc	Iron	Vit.A	Thia	Ribo	Niac	Asc.A.
CMG	2½	108	164	107	95	222	171	185	94	168
SH	3½	71	109	76	70	168	131	121	70	143
KM	4	66	106	61	66	96	111	101	71	50
CMH	4	79	122	86	69	143	122	134	72	93
SR	4	58	101	60	59	94	100	101	68	48
CF	4	75	104	91	49	112	97	128	52	52
JA	4½	66	126	111	64	177	118	152	66	124
JH	5	74	122	96	72	147	130	134	74	106
LI	6	41	60	100	33	53	64	80	33	24
MST	6	57	85	69	54	100	92	91	55	78
JS	6	67	104	83	67	141	112	110	67	120
MS	6	67	97	77	68	150	115	103	66	144
CM	6½	82	114	117	60	115	108	134	69	72
CH	7	75	116	97	78	135	129	120	75	113
CN	7	70	116	119	72	168	108	134	69	154
JG	7½	68	102	91	60	100	92	107	61	68
LH	7½	63	117	100	72	151	117	120	74	51
DMC	7½	91	130	121	84	132	146	139	83	101
DB	8	59	98	98	54	139	93	109	56	50
LW	8	71	112	77	79	151	128	106	81	89
TR	8½	89	146	151	81	157	146	162	83	128
JJ	8½	52	79	52	63	126	98	74	65	145

TABLE X. (continued)

Subject	Age yrs.	Calo	Prot	Calc	Iron	Vit.A.	Thia	Ribo	Niac	Asc.A.
RGM	8½	77	120	108	70	107	120	126	80	77
JB	10	70	107	76	73	145	114	115	76	160
JT	10	59	90	47	61	58	98	75	68	35
RVC	10	48	80	59	51	110	88	89	55	110
DV	11	60	103	75	59	59	95	115	64	36
RC	11½	68	110	78	70	122	111	119	72	63
CL	12	86	152	95	99	114	143	148	97	74
MM	13½	72	125	103	56	95	112	152	65	57
Mean		69	96	84	67	95	94	97	69	78

Table XI. Evaluation of nutrient intakes according to types of cerebral palsy expressed in percentages of the Recommended Dietary Allowances.

TABLE XI.

Types of Cerebral Palsy	Calo	Prot	Calc	Iron	Vit.A	Thia	Ribo	Niac	Asc.A.
Physiological									
Spastic	64	95	75	66	91	98	94	69	82
Mixed	72	98	86	72	95	98	88	72	77
Athetoid	71	95	96	64	94	95	97	67	70
Atonic	81	100	93	65	100	100	100	71	83
Topographical									
Quadriplegic	73	99	89	67	99	99	99	71	76
Diplegic	66	91	83	64	94	94	94	65	80
Hemiplegic	69	99	80	70	88	99	97	72	74
Paraplegic	69	100	84	67	100	96	100	66	84
Functional Capacity									
Class I	66	94	84	66	93	95	95	66	81
Class II	72	98	82	71	97	99	98	74	79
Class III	74	100	96	53	98	99	100	59	55
Class IV	66	100	81	65	98	100	100	69	75
Measured Intelligence Levels									
Normal	66	97	79	67	93	98	98	67	80
Level V	66	100	81	65	99	100	100	67	80
Level IV	72	95	89	71	95	96	96	73	74
Level III	69	95	88	60	100	95	97	66	79
Level II	65	95	74	68	79	99	88	69	68
Level I	66	100	100	64	100	100	100	66	100

Table XII. Evaluation of consistency of the diet, number of meals per week and number of between-meal items per week of all children in the study.

TABLE XII.

Subject	Age yrs.	Consistency of diet	No. of meals per week	No. of between-meal items per week
CMG	2½	1.16	21	54
SH	3½	1.19	21	23
KM	4	0.99	20	13
CMH	4	1.22	21	7
SR	4	2.98	18	29
CF	4	2.46	20	29
JA	4½	2.60	21	3
JH	5	1.60	15	29
LI	6	1.22	12	28
MST	6	1.33	21	6
JS	6	1.33	18	24
MS	6	1.30	21	16
CM	6½	1.61	21	19
CH	7	2.72	23	11
CN	7	4.45	21	18
JG	7½	2.18	17	25
LH	7½	1.93	21	5
DMC	7½	1.23	21	24
DB	8	1.63	20	17
LW	8	1.61	19	31
TR	8½	1.83	21	23
JJ	8½	1.31	21	0

TABLE XII. (continued)

Subject	Age yrs.	Consistency of diet	No. of meals per week	No. of between-meal items per week
RGM	8½	1.35	22	22
JB	10	1.39	19	15
JT	10	1.13	19	13
RVC	10	1.56	17	21
DV	11	2.09	13	21
RC	11½	1.98	23	14
CL	12	1.37	20	14
MM	13½	2.65	21	33
Mean		1.78	19.6	19.6

Table XIII. Evaluation of consistency of the diet, number of meals per week and number of between-meal items per week according to types of cerebral palsy.

TABLE XIII.

Type of Cerebral Palsy	Consistency of diet	No. of meals per week	No. of between-meal items per week
Physiological			
Spastic	1.95	18.8	19.9
Mixed	1.52	19.8	18.7
Athetoid	1.93	20.1	21.8
Atonic	1.42	21.0	13.0
Topographical			
Quadriplegic	1.72	20.8	17.4
Diplegic	1.56	18.1	25.1
Hemiplegic	2.17	19.9	16.4
Paraplegic	1.79	18.0	20.0
Functional Capacity			
Class I	1.89	19.3	17.2
Class II	1.55	19.6	21.9
Class III	2.56	20.5	31.0
Class IV	1.80	20.5	8.0
Measured Intelligence Levels			
Normal	1.77	20.4	15.3
Level V	1.55	18.4	22.0
Level IV	1.68	19.7	22.1
Level III	1.67	19.2	21.8
Level II	2.79	20.0	15.5
Level I	2.60	21.0	3.0

Table XIV. Types of between-meal snacks in descending order of popularity.

TABLE XIV.

Order of popularity	Between-meal item	No.of children consuming item	No. of times per week item consumed by 30 children
1.	Milk	24	99
2.	Candy	20	109
3.	Soft drinks	17	38
4.	Cookies	15	94
5.	Fresh fruits and vegetables	15	56
6.	Potato chips, corn chips and pretzels	12	22
7.	Sandwiches	10	19
8.	Fruit juice	8	18
9.	Cereal	8	13
10.	Cakes	8	12
11.	Popcorn	8	14
12.	Ice cream	7	14
13.	Doughnuts	6	12
14.	Crackers	5	27
15.	Kool-Aid	5	7
16.	Toast	4	6
17.	Dried fruits	3	8
18.	Pies	3	4
19.	Jello	2	3
20.	Rolls	2	3

TABLE XIV. (continued)

Order of popularity	Between-meal item	No.of children consuming item	No. of times per week item consumed by 30 children
21.	Cocoa	2	2
22.	Fudge	2	2
23.	Gum	2	2
24.	Nuts	1	1
25.	Tea	1	1
26.	Custard	1	1

DISCUSSION

The greater need of the cerebral palsied for dentistry has been pointed out in the literature. This need can be attributed to many factors heretofore discussed: lack of dental care due to ignorance and neglect on the part of both the parents and the dental profession; inability to control the muscular activities of the tongue, cheeks and lips, resulting in poor oral hygiene and prolonged retention of food particles in the oral cavity; lack of activity and/or over-activity of these same muscles which are responsible for many malocclusions, and common occurence of poor diet and nutrition among these patients.

This study was concerned with only one of countless factors which can affect the oral status of the cerebral palsied child.

Quite frequently the terms nutrition and diet have been used interchangeably. However, they are not synonymous, and it is important to understand the meaning of each.

Nutrition refers to the utilization of food and is dependent upon digestion, absorption, assimilation and excretion, the metabolic functions of the living cells and organisms. Diet, on the other hand, refers to the food and drink which are taken into the mouth.

It includes nutritional as well as non-nutritional factors. Brauer et al.[109] pointed out that nutritional factors of diet involve the essential chemical substances such as protein, carbohydrates, fats, minerals and water, as well as the accessory chemical substances which are vitamins and minerals. They are absorbed by the gastrointestinal tract, enter the blood stream and are utilized by the cells. The non-nutritional factors are concerned with the physical character and local action of food.

The dental profession must constantly stress the importance of optimum dietary intake among the patients. This is not only essential for oral health but also for the general well-being of the entire human body.

The dietary intake can affect the oral structures in two ways: (1) indirectly, due to systemic factors. Deficiencies in nutrients such as vitamins, minerals and proteins have been shown to promote and create severe disease conditions in the oral cavity; (2) directly, by the local influence of the diet. Content and physical form of the diet have been associated with enumerable abnormalities that dentists constantly face.

Some dietary effects upon the teeth and the

periodontal tissues have been reviewed. It can be stated that the dental profession is in an excellent position to counsel patients on good dietary practices.

Dentists do not evaluate diet in the same manner as do nutritionists. Similarly, nutritionists may draw varying conclusions from diet studies as compared to physicians interested in the diets of their patients. This study was conducted by a dentist and therefore from the viewpoint of his profession.

Although parents of 57 cerebral palsied children were requested to take part in the study, only the parents of 30 of the children cooperated and completed the surveys. The lack of interest shown by parents was rather surprising. Most parents who did not cooperate apparently did not want to take the time to complete the surveys; others did not have the time to keep account of all the food their children consumed.

This dietary study was primarily evaluated according to the four food groups rather than the amounts of nutrient consumption. It was thought to be a more practical method of analyzing the diet and counseling the parents on the dietary needs of their children since most people think in terms of foods rather than nutrients.

Evaluating the nutritional status by merely determining the nutrient consumption was impractical since some children were taking vitamin supplements. Furthermore, it was noted that the recommended allowances can be met even with an unbalanced diet if certain foods are consumed in excessive amounts.

When evaluating the diets of children, one must consider that the amount contained in a serving is much smaller in younger children. For example, a glass of milk served with a meal for a four-year-old contained four ounces, whereas a glass of milk for a 12-year-old child was eight ounces. Only the actual amount consumed was considered in this study. Thus, four ounces of milk consumed by a four-year-old was considered one-half of a serving; similarly, eight ounces of milk consumed by a 12-year-old was considered one full serving. This same principle was employed in evaluating the amount in the servings of the other food groups. Obviously, it was difficult for children of younger ages to meet the recommended number of servings of food since their servings were smaller than those of the older ages. Nevertheless, this fact was compensated for by the lower values specified in the Recommended Dietary Allowances for younger children (Table IX).

The recommended number of servings of foods in the four food groups is considered a minimum for a normal child.

Generally, the cerebral palsied children showed pronounced deficiency in food consumption; no child in this study consumed food to an excessive amount. The cause for the deficiency is most difficult to assess. It is conceivable that these children require less food than the unaffected children. Phelps[95] has pointed out that many cerebral palsied children are limited in their activities; they do not move around very much. Therefore, their caloric requirements are low. However, Phelps has also pointed out that some cerebral palsied children require greater consumption of food than the recommended allowance to maintain their body weight.

When the diets of the cerebral palsied children were evaluated on the basis of the four food groups, the pattern of nutrient intake was clearly demonstrated. For example, because milk is a good source of calcium, a child deficient in milk consumption was likely to have a low calcium intake.

The mean consumption of the milk group was 78 per cent of the recommended amount. This was a consumption of 19.0 ounces of milk per day. Only eight

children consumed 100 per cent or more of the recommended amount. The mean consumption was in agreement with the amount reported by Hammond[103] (mean intake of 22 ounces per day) and Peeks and Lamb[96] (mean intake of 16 ounces per day) on their dietary studies of cerebral palsied children; however, it was lower than the amount reported by Karle and co-workers[101] (mean intake of one quart or 32 ounces per day). When comparing observations regarding milk intake, the age of the children in the studies should be considered. Obviously, older children will consume more milk than the younger ones. One must also consider the method of calculation used to arrive at a mean. In the present study, any food consumption which was above 100 per cent of the recommended amount was considered 100 per cent intake. This method of calculation was used primarily to minimize the variability introduced when children consumed food in excess of the recommended amount. Their excessive consumption did not affect the deficient consumption shown by other children.

Karle and co-workers[101] found that meat and meat substitutes were well eaten by the cerebral palsied children, Hammond[103] found deficiency in meat consumption by the handicapped, and others[91-93] have

discussed the difficulty the cerebral palsied children encounter in eating firm food such as meat and raw vegetables.

The present study showed that the cerebral palsied children were deficient in meat consumption, but whatever meat they consumed was generally in a hard physical form. The nutrient evaluation revealed that even a slight deficiency in the meat consumption affected the intake of iron and niacin in these children. Since iron and niacin intake was low and the meat group is the best source of these nutrients, a need for greater consumption of foods in the meat group was indicated.

The vegetable-fruit group was the most deficient food group among the cerebral palsied. Since foods in this group are an excellent source of vitamin A and ascorbic acid, deficiency in these vitamins was expected. It was interesting to note, however, that 24 children had an adequate intake of vitamin A and 13 children consumed foods which accounted for an adequate amount of ascorbic acid. The primary source of ascorbic acid is found in the fruits and vegetables; most children who had deficiency in fruits and vegetables had deficiency in ascorbic acid intake. Vitamin A, on the other hand, is not only provided by

foods in the vegetable-fruit group but also by the other food groups. This is the reason for the relatively good vitamin A intake in these children.

It was also interesting to note that the allowances for vitamin A and ascorbic acid were very adequately met with a consumption of the minimum recommended amounts of fruits and vegetables.

The bread-cereals was the food group consumed most readily by the cerebral palsied children. However, the diets of 19 children were deficient in these bread and cereal foods. Previous studies[101, 103] have shown that food in the bread-cereals group was well eaten by the handicapped children. This food group was not the main source of any specific nutrient, but it contributed to most nutrients.

In the nutrient evaluation of the diets, the cerebral palsied children showed, in the order listed, deficiencies in iron, calories, niacin, ascorbic acid, and calcium. This was in agreement with Leamy's[97] findings. In addition, Leamy found protein to be quite deficient in the handicapped; however, the present study showed that the protein requirement was well met by most children. Hammond[103] also found that protein allowances were well met. Low intakes of calories, iron and niacin were consistently

demonstrated in all children. Two factors were responsible for this finding: first, the method employed to analyze the nutrient value. Secondly, a deficiency of foods which have a high content of iron and niacin has been demonstrated in these children. It should be noted, however, that no method can measure precisely the nutritive value of any diet. Whiting and Leverton[110] have pointed out that every method has room for improvement. Perhaps a combination of several techniques is the most accurate method of processing the dietary data.

Although the method used in this study may not have been the most accurate for analyzing the nutrient values, the results clearly demonstrated the need for a balanced diet and revealed the relative nutrient content of the diets of these children.

The findings related to consistency of the diet showed that cerebral palsied children did consume soft food. The milk group was almost entirely soft since most of the food in this group was consumed as a beverage. More bread and cereals were consumed in a soft form than in a hard form. Meat, fruits and vegetables were evenly distributed between soft and hard physical forms.

Album[5, 98] pointed out that the handicapped

children require softer food than the non-handicapped. Findings in the present study did not show this to always be the case, although some trend toward consumption of softer food was noted. Perhaps this situation exists more frequently in the severly disabled children. The dietary records of all the cerebral palsied children except one (CN) showed that the method of preparing and serving the food was not unusual.

The diet of a seven-year-old spastic hemiplegic female (CN) had a consistency index of 4.45. This was unusual since this was the only diet above the index of 3.00. The dietary record of CN showed that most of her food was in a soft form. Meats were finely cut or chopped to facilitate eating; many vegetables were served in a creamed and processed form, and soft bread was a very common item consumed.

In general, cerebral palsied children consumed meals with an extremely good regularity. The mean number of meals consumed per week was 19.6. It appeared that most parents did not let their children go without food for a long period of time. Evidently, the parents realized that these children, because of their low dietary intake, needed food at every opportunity. This fact was demonstrated by the high number

of nourishing between-meal snacks. Especially noteworthy were the 19 sandwiches consumed by 10 children, which ranked seventh in popularity among the 26 between-meal snacks. However, only seven of the 19 sandwiches were of sufficient quantity to be considered meals.

It was evident that a more adequate diet was consumed by children who ate more between meals. One child (CMG) who had 54 between-meal items per week consumed a large quantity of food of high nutritional value. Another child (JJ) with no indication of between-meal eating showed very poor dietary intake both in regards to food groups and nutrient values.

In evaluating the number of between-meal items consumed, it was difficult to assess the number of times a particular type of candy was consumed. For example: (1) a child consuming 11 pieces of Hershey's milk chocolate kisses was considered consuming this item three times, i.e. any amount less than four pieces was considered one candy, and any amount from five to eight pieces was considered two candies, etc.; (2) similarly, any amount less than five jelly beans was considered one candy; and (3) any portion of a whole candy bar consumed was considered one candy.

Perhaps another good method of assessing the number of times a candy was consumed is to evaluate the consumption by the weight of the product.

A study of between-meal eating habits conducted by Weiss and Trithart[62] on unaffected children showed that gum was the most popular item. In the present study, milk was the most popular snack item; gum ranked 23rd in popularity. It was interesting to note that even with all the milk consumed during the snack periods, the deficiency in the milk group was the second greatest among the four food groups. Some severe milk deficiencies could have occurred if these children had avoided milk during their snack periods.

The quality of between-meal items consumed by cerebral palsied children appeared to be somewhat better than that found in Weiss and Trithart's study. It was surprising to learn that so many nutritionally good foods were consumed at between-meal periods. This fact supports the earlier assumption that these children are encouraged to eat "good" food whenever feasible because of their low nutritional intake.

The distribution of samples was uneven in all four classifications of cerebral palsy. According to the physiological classification, four types of cerebral palsy were represented; only two children

were atonic (Table II). By topographical classification, four types were also represented; only two children were paraplegic (Table III). According to functional capacity classification, only two children were Class III type and two others were Class IV type (Table IV). By mental retardation classification, only three children were in Levels I and II (Table V).

Thus, with the small number and uneven distribution of the samples, it was difficult to make conclusions about the effects of the disablement on the dietary habits of these children. However, some meaningful results have been presented in the data.

SUMMARY AND CONCLUSIONS

A study of the dietary habits was completed for 30 cerebral palsied children. Fifteen of the subjects were boys and 15 were girls, all ranging in ages from two and one-half to 13½ years. The children included in the study were patients at the Cerebral Palsy Dental Clinic of the Indiana University Medical Center. The parents of the children were given identical instructions in keeping a record of the seven-day food intake.

The investigator analyzed the effects of the various forms of disability, as related to cerebral palsy, on the dietary habits of the children. Each child was classified according to the physical involvement of cerebral palsy and to mental capacity; (1) The physiological classification separated the children according to the involvement of motor functions. Spastic, athetoid, mixed and atonic types were represented in the study. (2) The topographical classification described the distribution of the physical involvement. Quadriplegic, diplegic, hemiplegic and paraplegic types were represented. (3) The functional capacity classification divided children according to the degree of physical involvement. All degrees of capacity were represented. (4) The mental retardation classification placed all children

according to their intelligence levels.

Nutritional adequacy of the diet of each child was evaluated by the number of servings of food consumed in the four food groups. The amount of nutrients contained in a serving of food in the four food groups was calculated from Table 6 of the Essentials of An Adequate Diet[105] (Table VIII). Therefore, in order to estimate the amount of nutrients contained in a seven-day diet, the amount of nutrients contained in a serving was multiplied by the number of servings of foods consumed per week. All data relevant to the nutritional adequacy of the diet were evaluated according to the standards (minimum recommended amounts) set up by the Agricultural Research Service[105] and the National Research Council[107] and were expressed as percentage consumptions. For the calculation of mean intake, any intake over 100 per cent of the standard was considered 100 per cent intake.

The dietary evaluation according to the four food groups revealed that each child in the study group was deficient in one or more of the food groups.

The mean milk consumption was 78 per cent of the recommended amount (19.0 ounces per day). Severe milk deficiency was noted in children who substituted

for milk beverages which were low in nutritional value. Since milk is a good source of calcium, children who had a deficiency in the milk group frequently had a less than adequate calcium intake. Spastic children consumed significantly less milk than the children in the other cerebral palsy groups; there was a trend toward an increased consumption of milk with an increased severity of the disease.

The mean percentage intake of foods in the meat group was 80. The consumption of meat, although low for the entire group, was high in many children. Paraplegics and hemiplegics showed the best meat consumption. Because of the low intake of iron and niacin shown in the nutrient evaluation, an increased consumption of meat was indicated.

The vegetable-fruit group was the least popular of the four food groups; the mean intake was 61 per cent. Only three children had over 100 per cent of the recommended number of servings. Many children were severely deficient in this group; those who were deficient also demonstrated low ascorbic acid intakes because fruits and vegetables are the only source of this vitamin. There was a trend toward decreased consumption of fruits and vegetables as the severity of the disease increased.

The bread-cereals food group was the one best consumed by the cerebral palsied children. This food group was not a source of any specific nutrient, but provided a little of most nutrients. However, 19 children still failed to meet 100 per cent of the recommended amount. The mean intake of food in this group was 84 per cent.

When the nutrient content of the diets was determined, the cerebral palsied children showed greatest deficiencies in iron, calories and niacin; deficiencies to lesser degrees were shown in ascorbic acid and calcium. The allowances for riboflavin, protein, vitamin A and thiamin were well met. Three children took vitamin supplements daily, but vitamins were not included in the evaluation of nutrients.

The group of spastic children consumed less calories than those of the other cerebral palsy groups; the calcium intake was also low in the spastics. Otherwise, the various ways in which these children were afflicted by the disease did not influence nutrient intake.

The ratio of soft to hard food in the diet determined the consistency index for each child. Thus, a softer diet was indicated by a higher index number. The children generally ate soft food, but the methods

of preparing and serving the food were not unusual. The consistency of the diet had a wide margin of variation. The consistency index ranged from 0.99 to 4.45.

The children in the study group showed a surprisingly good regularity in meal consumption. The children as a group missed on the average about one meal per week. Evidently, parents realized the need for greater food intake.

The cerebral palsied children consumed approximately three between-meal items per day, with milk being the most popular. Twenty-four of the 30 children consumed milk 99 times during between-meal periods. Children who ate more, both during meals and between meals, had more adequate diets.

This study was strictly concerned with the cerebral palsied children; the diets of the subjects were not compared with those of unaffected children of the same age. The possibilities for future studies are unlimited. A further study comparing the normal to the handicapped is indicated; the socioeconomic status of the families should be investigated; the cultural, educational and religious backgrounds of each family should be considered; and a larger sample is indicated as it was difficult to arrive at some conclusions due to the smallness of the sample.

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CURRICULUM VITAE

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ABSTRACT

Dietary habits of 30 cerebral palsied children were investigated in this study using seven-day intake records obtained from their parents. Each child was classified in terms of physiological and topographical involvement, functional capacity, and mental retardation. All food records were evaluated in terms of the four food groups, and the nutritional adequacy and consistency of the diet were analyzed. The average number of meals per day and the frequency and types of between-meal snacks were evaluated.

The cerebral palsied children, as a group, showed pronounced deficiency in all four food groups being most deficient in the vegetable-fruit group and least deficient in the bread-cereals group. In terms of nutrients, the children showed deficiencies of iron, calories, niacin, ascorbic acid, and calcium, in the order listed. The children generally consumed soft food, ate their meals at surprising regularity, and snacked approximately three items per day. Their snacks consisted of items of high nutritional value.

Dietary habits did not vary significantly when they were evaluated according to types of affliction. Some effects on the consumption of milk and fruits and vegetables were observed, but because each type of cerebral palsy was not well represented, results did not warrant definite conclusions.